

Climate-erosion coupling over the Himalaya during past ~100 ka

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In this study efforts are made to study the erosional history of the central Himalaya through the records preserved in the Gangetic plain. Sediments from a ~50-m long core, raised from the Ganga Plain at Kanpur and representing ~100 ka of flood-plain deposition [1], were analysed for Sr and Nd isotope composition.

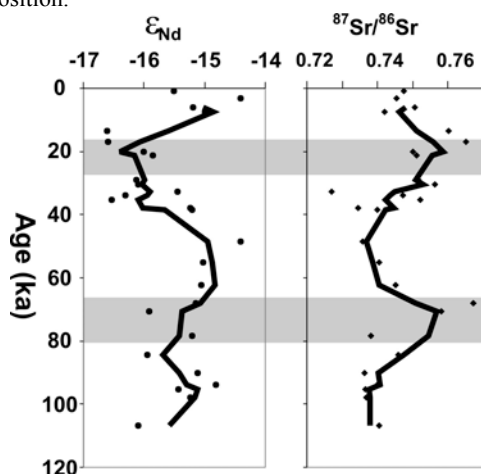


Figure 1: Nd and Sr isotope variation in the sediments

Both $^{87}\text{Sr}/^{86}\text{Sr}$ and ϵ_{Nd} vary significantly with depth in the core, 0.72701 to 0.76708 and -14.4 to -16.6 respectively, within the range for silicate rocks of the Higher and the Lesser Himalaya [2]. The variations in the isotope composition of these sediments reflect variations in the mixing proportion of sediments from the Higher and the Lesser Himalaya, the two major sediment sources to the Ganga. The isotope profiles exhibit two major excursions at ~ 20 ka and ~ 70 ka coinciding with periods of precipitation minima [3] and larger glacial extent [4] over the Himalaya. These excursions are result of decrease in the proportion of sediment from the Higher Himalaya due to decrease in monsoon precipitation and increase in glacial cover which in turn are caused by lower solar insolation. This study highlights the significant influence of climate on erosion in the Himalaya and indicates that there is almost no time lag between transfer of sediments from their generation site to deposition site.

- [1] Sinha *et al.* (2007) *Sed. Geol.* **201**, 386–411. [2] Singh *et al.* (2008) *Jour. Geoph. Res.*, doi:10.1029/2007JF000909. [3] Prell & Kutzbach (1987) *Jour. Geoph. Res.* **92**, 8411–8425. [4] Owen *et al.* (2007) *Quat. Sci. Rev.* **21**, 147–157.

Understanding the fundamental mechanisms of CaCO_3 in water

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Calcium carbonate is one of the most widespread and studied minerals, especially within the field of biomineralization. Despite this, a complete understanding of the atomic mechanisms controlling its precipitation and dissolution in water is far from being achieved. Amongst the reasons why this material remains challenging are the long time scales and system sizes that are necessary to study this problem, which overwhelm even classical molecular dynamics simulations. The use of special techniques to accelerate the sampling of the configurational space is therefore an imperative. In this presentation, we report our recent results on the fundamental atomic mechanisms that control the diffusion of species on the flat and stepped (10^{-14}) calcite surface in water, which underpin the macroscopic growth and dissolution processes. The calculation of the ions solvation free energies as well as bulk properties provide an ultimate validation of the force field in describing the complex behaviour of the calcium carbonate/water interface. The use of metadynamics proves to be effective in accelerating the exploration of the potential energy surface and thereby determining the free energy barriers for relevant diffusion mechanisms.